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RED SQUIRREL RESPONSE TO CLEARCUT AND SHELTERWOOD SYSTEMS IN INTERIOR ALASKA

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ABSTRACT

Population response of red squirrels to clearcut and shelterwood silvicultural systems in interior Alaska was determined by counting the population before and after cutting. Following harvest, all territories from the clearcuts were vacated and the number of squirrels in the shelterwood decreased from 1 per 0.69 ha to 1 per 2.0 ha. The squirrel population in the adjacent control area and along the cutting area boundary remained stable.

KEYWORDS: Red squirrels, *Tamiasciurus hudsonicus*, shelterwood cutting method, clearcutting systems.

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Red squirrels (*Tamiasciurus hudsonicus*) are widely distributed throughout the coniferous forests of interior Alaska (Hall and Kelson 1959). These animals inhabit mature forests and feed primarily on seeds of white or black spruce (*Picea glauca*; *Picea mariana*) (Dice 1921, Murie 1927, Brink and Dean 1966). They are solitary; males and females are equally aggressive in defending individual territories ranging in size from 0.4 to 1.3 ha^{2/} (Klugh 1927, C. C. Smith 1965). In a homogeneous white spruce forest, this type of social behavior tends to distribute the animals in a regular pattern. Populations and territory size are quite stable; however, they are known to fluctuate in direct response to food availability (C. C. Smith 1968, 1970; M. C. Smith 1968).

Forest harvesting is a common means of altering the white spruce type, and thus red squirrel habitat, in the boreal forest. Clearcutting will obviously result in habitat destruction and population decline. However, the effects of stand density reduction (e.g., a shelterwood) and the squirrel response along the periphery of a clearcut are not known. The objective of this paper is to examine the short-term response of a squirrel population to the clearcut and shelterwood silvicultural systems.

STUDY AREA

The study area was located in a mature white spruce stand within the Bonanza Creek Experimental Forest 30 km southwest of Fairbanks, Alaska (64° 50' N. lat.). The largest spruce were over 125 years old, approximately 30 m high with a diameter at breast height of 40 cm. Quaking aspen (*Populus tremuloides*), alder (*Alnus crispa*), and paper birch (*Betula papyrifera*) were the only other large vascular plants on the study area.

The study area was divided into three clearcuts--two 1-ha and one 1.6-ha--and three shelterwoods each 2.4 ha in area (fig. 1). The average density of white spruce before logging was 472 trees per ha (189/acre). After harvest, the clearcuts had no trees standing, and the shelterwoods had 81 trees per ha (33/acre).

METHODS

Before harvest in June 1972, all squirrel middens in the study area and within a 70-m zone around the cutting units were counted and mapped. Diameter of an average size territory is 70 m.^{3/} A midden is a large accumulation of spruce cone bracts stripped by the squirrel which cover an underground food cache (M. C. Smith 1968). A midden count can be used as an index to estimate population size since each active midden is the work of one squirrel and each squirrel has no more than one midden (Gordon 1936, Clarke 1939, Kilham 1954, C. C. Smith 1965, M. C. Smith 1968). A similar count was made in the fall of 1974, 2 years after all designated trees had been cut and removed. Field observations were made to determine if any squirrel occupied more than one midden or if territorial boundaries overlapped. Squirrels were not marked, and thus some of these observations were subjective. If a midden had been moved to less than 15 m from its original location, it was mapped as being in the same place.

^{2/} W. D. Fitzwater, Jr. The red squirrel: territorialism, activity, census methods. M.S. thesis, New York State College of Forestry, Syracuse, 117 p. 1941.

^{3/} D. P. Streubel. Food storing and related behavior of red squirrels (*Tamiasciurus hudsonicus*) in interior Alaska. M.S. thesis, University of Alaska, Fairbanks, 56 p. 1968.



Figure 1.--Aerial photo of study area after logging.

RESULTS AND DISCUSSION

Before harvest (1972), there were 39 middens in the total cutting and peripheral area of 25.4 ha or 1 squirrel per 0.65 ha. After harvest (1974), the number of animals was reduced to 23. The distribution of these squirrel middens is shown in figure 2. All territories from the clearcuts were vacated, but squirrels were observed in the clearcut in the summer of 1973 at old middens. The number of squirrels in the shelterwoods decreased from 1 squirrel per 0.69 ha in 1972 to 1 per 2.0 ha in 1974 (table 1). Animals which remained in the shelterwood areas increased their home range and incorporated some of the adjacent control area into their territories. Territory size may be

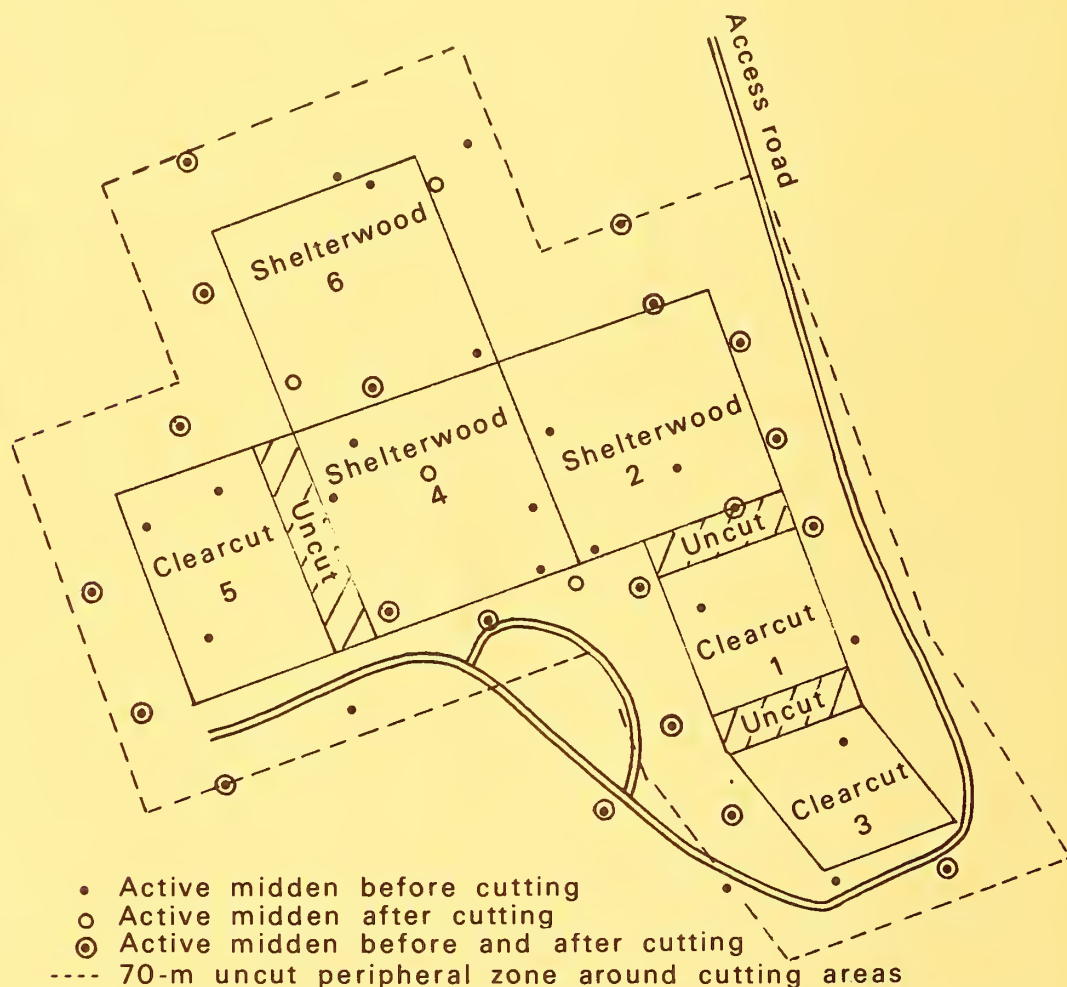


Figure 2.--Map of the cutting units and peripheral control area showing location of middens before and after logging.

TABLE 1.--Description of experimental areas showing territory size before and after logging

Treatment	Area	Number of hectares per squirrel	
		Before logging (1972)	After logging (1974)
<u>Hectares</u>			
Clearcut:			
Unit 1	1.0	1.00	0
Unit 3	1.0	1.00	0
Unit 5	1.6	.53	0
Average		<hr/> .84	0
Shelterwood:			
Unit 2	2.4	.80	2.40
Unit 4	2.4	.48	1.20
Unit 6	2.4	.80	2.40
Average		<hr/> .69	2.00
Uncut forest:			
Adjacent to study area	14.6	.63	<u>1/</u> .76
3 km from study area ^{2/}	21.0	<u>3/</u> .75	.66

^{1/} Three squirrel middens along road right-of-way and log decks were vacated.

^{2/} Gary Searing. Aggressive behavior and population regulation of red squirrels (*Tamiasciurus hudsonicus*) in interior Alaska. M.S. thesis, University of Alaska, Fairbanks, 74 p. 1975.

^{3/} 1971.

adjusted to the quantity of food contained in the territory (C. C. Smith 1965, M. C. Smith 1968). Patton (1974) found that densities of Abert's squirrels decreased with a more open crown canopy and wider spacing of ponderosa pine trees. In the uncut areas around the harvested units, population densities dropped from 1 squirrel per 0.65 ha in 1972 to 1 per 0.76 ha in 1974. This change can be at least partially related to vacated middens in or close to road rights-of-way or log decks. In a mature spruce stand approximately 3 km from our study area, the population was 1 squirrel per 0.75 ha in 1971 and 1 per 0.66 ha in 1974.^{4/} Squirrel densities in the past 10 years ranged from

^{4/} Gary Searing. Aggressive behavior and population regulation of red squirrels (*Tamiasciurus hudsonicus*) in interior Alaska. M.S. thesis, University of Alaska, Fairbanks, 74 p. 1975.

1 per 0.65 ha to 1 per 5.3 ha, with the lowest densities during years following cone-crop failure^{5/} (also see footnotes 3 and 4).

Cone production from 1970 to 1973 was observed in detail in three mature white spruce stands within 5 km of the study area and less intensively in the study area. These observations indicated that 1970 and 1972 were excellent cone and seed years. All dominants and codominants produced at least 500 cones, and many produced more than 1,000 cones. No cones were observed on any trees in 1971; in 1973 the majority of trees produced less than 50 cones, and the most observed on any tree was less than 200. Thus, the squirrels in the study area were probably most dependent on cones cached in 1972 with a small contribution from the 1973 crop.^{6/}

SUMMARY

Short-term response under the particular set of management conditions imposed here resulted in the squirrels' vacating clearcuts and in reduction of their numbers in shelterwoods. Populations in adjacent uncut stands remained stable, or increased slightly. The long-term suitability of the shelterwood will be determined both by the response of squirrels to the more open stand conditions, especially the spacing of cone-bearing trees, and by cone production.

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^{6/} Unpublished data on file at the Institute of Northern Forestry, USDA Forest Service, Fairbanks, Alaska.

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